Flat-Field Calibration of CCD Detector for Long Trace Profilers

Jonathan L. Kirschman, Edward E. Domning, Steve C. Irick, Alastair A. MacDowell, Wayne R. McKinney, Gregory Y. Morrison, Brian V. Smith, Tony Warwick, and Valeriy V. Yashchuk

Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, California, 94720

The next generation of synchrotrons and free electron lasers requires x-ray optical systems with extremely high-performance, generally, of diffraction limited quality. Fabrication and use of such optics requires adequate, highly accurate metrology and dedicated instrumentation. In the present paper, we discuss a way to improve the performance of the Long Trace Profiler (LTP), a slope measuring instrument, widely used to characterize x-ray optics at low-spatial-wavelengths from approximately 2 mm to 1 m. One of the major sources of the LTP systematic error is the detector [1]. For optimal functionality, the detector has to possess the smallest possible pixel size/spacing, a fast method of shuttering, and minimal non-uniformity of photoresponse. While the first two requirements are determined by choice of detector, the non-uniformity of photoresponse of typical detectors such as CCD cameras is around 2-3%. We describe a flat-field calibration setup specially developed for calibration of CCD camera photo-response and dark current with an accuracy of better than 0.5%. Such accuracy is adequate for use of a camera as a detector for an LTP with performance of ~0.1 microradian (rms). We also present the design details of the calibration system and results of calibration of a DALSA CCD camera used for upgrading the LTP-II instrument, available at the ALS Optical Metrology Laboratory. This work was supported by the U. S. Department of Energy under contract number DE- AC02-05CH11231.

[1] V. V. Yashchuk, *Positioning Errors of Pencil-beam Interferometers for Long Trace Profilers,* Proceedings of SPIE Vol. 6317, 63170A (2006).